

Subject: Recommendations for Identifying Areas for Adding Volumes Associated with Dredging Contaminated Sediments to Navigable Depths in Lower Duwamish Waterway.

1. Purpose. EPA has requested technical assistance from the Seattle District, US Army Corps of Engineers (USACE) to explore the effect of incorporating new information and other potential modifications to the Proposed Plan Preferred Alternative on area, volume and cost estimates. This memorandum documents additional volumes and acreages to be dredged and associated costs based on: incorporation of new data; modifying an assumption made in the FS and carried into the Proposed Plan regarding cap buffer zones in the Federal navigation channel; and modifying an assumption in the Proposed Plan regarding contamination levels and depths that would trigger remedial action in the Federal channel.

This information is needed to address a comment (USACE 2013b) on the Proposed Plan that the Preferred Remedy did not adequately address contamination that is present and could impede USACE's ability to maintain the Federal channel. EPA is considering the impact of new information and of leaving deeper, unaddressed contamination in the channel. This memorandum uses the following terms to categorize and quantify the new data: "Clean" and "Dirty" sediments are based upon chemical and biological Remedial Action Levels (RALs) in the Selected Remedy. However, with regard to sediment deeper than 2 ft below mudline, the FS (LDWG 2012a) and supplemental scenarios memoranda (LDWG 2012b, 2013a) did not include RALs for intervals deeper than the top 2 ft. In this memorandum, exceedance of the top 2 ft RALs was provisionally used to define "Dirty" for depths greater than 2 ft below mudline and above the normal maintenance dredging depth in the Federal channel. Dirty/Dirty denotes that one or more RALs are exceeded in the surface top 2-ft depth interval as well as the deeper layers. Clean/Dirty denotes that contaminant concentrations in the top 2-ft interval are below RALs, while subsurface sediments exceed the provisional deeper RALs.

This memorandum considers 3 cases. The base case and Scenario 1 described below would require remediation, but the Clean/Dirty case (Scenario 2) would not, unless a provisional deeper RAL were established by EPA.

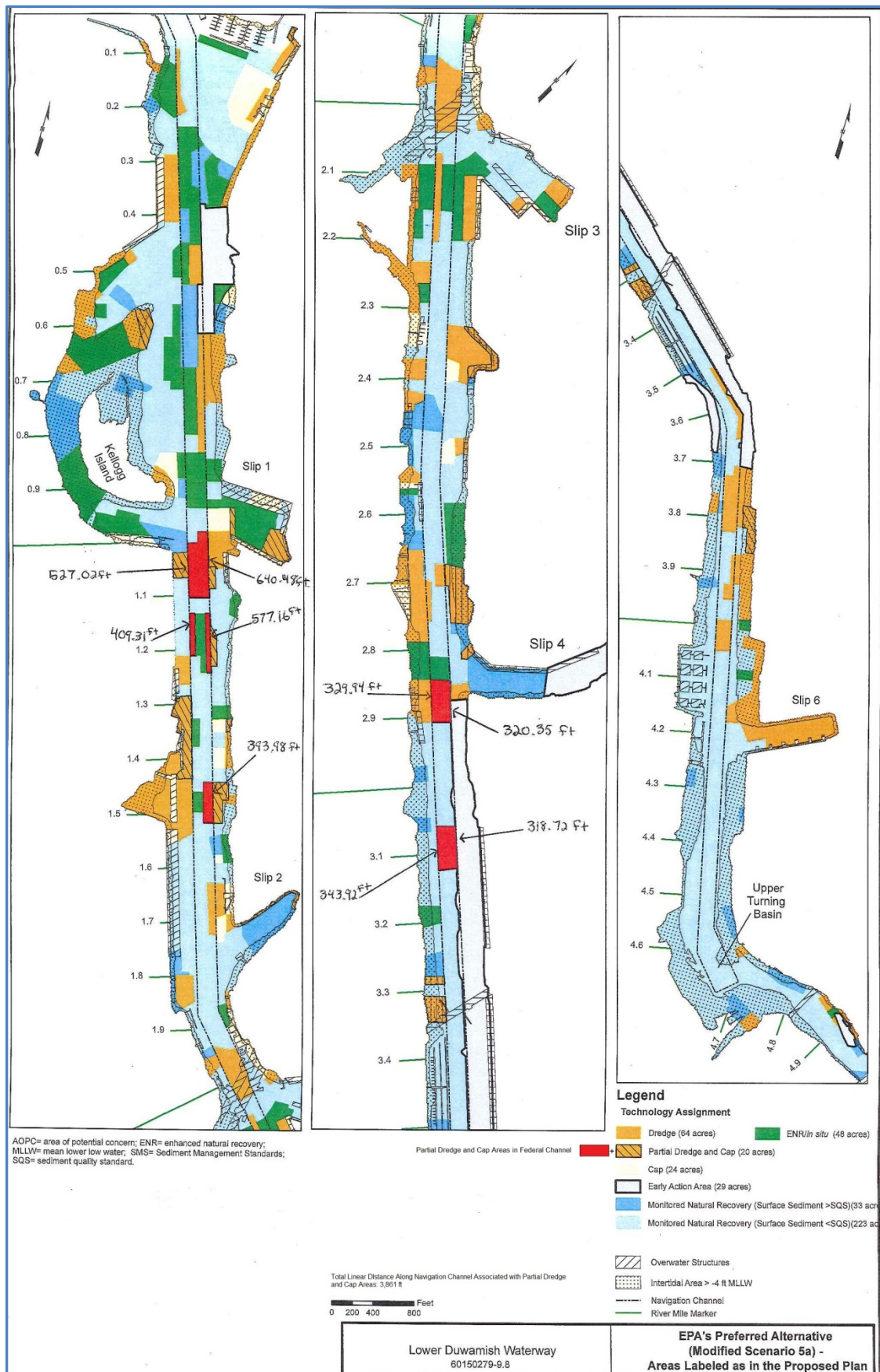
- The base case is as presented in the Proposed Plan for Alternative 5C Plus (the Preferred Alternative).
- Scenario 1 adds the following to the base case.
 - Additional volumes, acreages and costs for providing one additional foot to comprise a two-foot buffer zone for caps in the Federal channel, as requested by the USACE during the Feasibility Study (but not followed by the PRP group).
 - Additional volumes, acreages and costs for increased remediation in accordance with new data from the USACE characterization from 2012 (i.e., too late to be included in the FS) with updated 2013 USACE bathymetry (the FS used 2003 bathymetry). This scenario

identifies Dirty/Dirty sediments subject to remediation in the existing Selected Remedy, but not previously quantified due to the cut-off for information used in the FS. .

- Scenario 2 adds to Scenario 1 Clean/Dirty volumes, acreages and costs from the USACE characterization that would not currently result in remediation requirement under the current scheme. These would not currently be subject to cleanup, and would leave materials at depth that USACE would not be able to dredge under the Navigation Program.

2. Additional Volumes and Acreages Associated with the Cap Buffer.

Figure 1 shows areas that will be partially dredged and capped within the Federal channel in accordance with Alternative 5C Plus. A total of 6.9 acres, or 11,132 cubic yards would need to be dredged at the bottom of this to provide an additional foot. Also, 3,900 linear ft of the boundaries of the navigation channel would need to be cut back accordingly (a 0.6 ft per ft rise) to assure stability of the margin, accounting for an additional 2,600 cubic yards (CY). Jointly, 13,732 CY (rounded up to 14,000 CY) increase would occur, with no significant acreage increase associated with the cutback.



3. Additional Volumes and Acreages Associated with New Navigation Characterizations.

Estimates of volumes/acreages/costs in the FS (LDWG 2012a) and technical memoranda following it (LDWG 2012b, 2013a) were based upon a 2003 navigation survey by USACE. USACE (2013a), based upon recent topographic surveys, completed in 2012 a characterization study for shoaled areas in the Lower Duwamish Waterway from river miles (RM) 0 to 4, which included chemical analyses of core samples and some bioassays. Figure 2 shows the location of these samples from the LDW Federal channel against the backdrop of the Preferred Alternative in the Proposed Plan. EPA wishes to know if there are additional volumes beyond those estimated in the FS due to these new data on the extent of shoaling in the past 10 years, and the contaminant concentrations within those shoals. EPA also wishes to know whether there are shoals characterized by USACE that would not require remediation based on Proposed Plan criteria in the upper 2 ft, but are “dirty” above the authorized depth of the Federal channel, and thus could not be dredged by the USACE in its navigation program. As noted, this information is needed to address a comment (USACE 2013b) on the Proposed Plan that the Preferred Remedy did not adequately address contamination that is present and could impede USACE’s ability to maintain the Federal channel, as well as comments by the Lower Duwamish Waterway Group (LDWG 2013b) and others that more recent information than in the FS would increase the costs of the remedy. LDWG commented that Ecology and USACE data jointly would increase the undiscounted costs by \$31M (\$25M discounted at 2.3%); several businesses estimate the volume increases could increase costs by as much as \$100M (unstated in comment, but probably an undiscounted value). However, these parties did not provide information about how they arrived at these estimates.

This analysis provides an estimate of the volume and cost increase due to newer information (that is, with no changes to the remedial action levels). It also provides an estimate of further volume/cost increases.

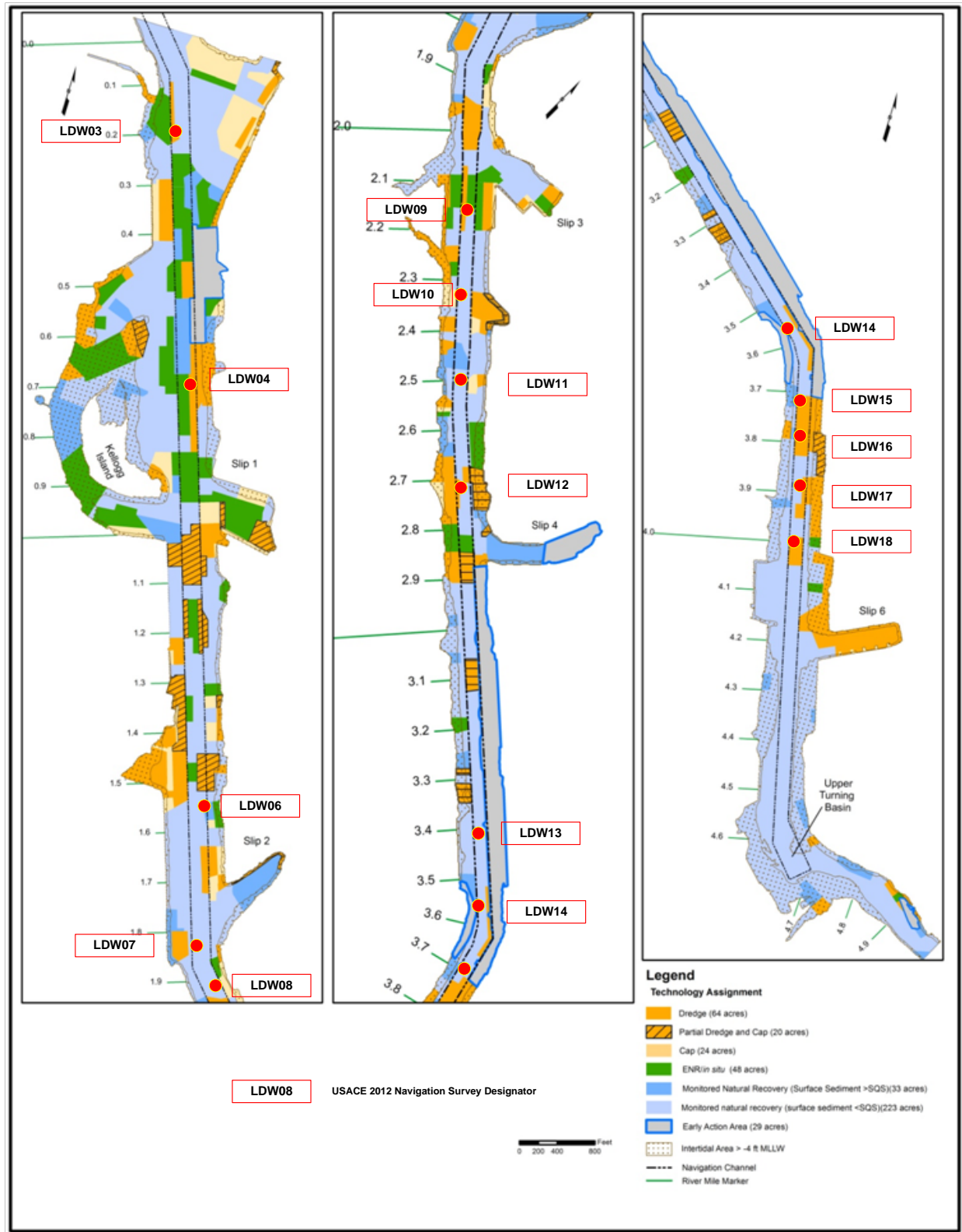


Figure 2. Selected Remedy from Draft ROD, Showing Locations of USACE Navigation Channel Characterization

3.1 Remedial Action Levels

The type of remediation to be used at a location depends upon interpretation of Remedial Action Levels (values for human health [HH COCs] or benthic protection [benthic Sediment Cleanup Objectives or SCOs]) according to the following:

- Location:
 - In the Federal channel
 - In Recovery Category 1 or in Recovery Categories 2 or 3
 - In potential tug-scour areas (applies only to PCBs in the top 2 ft)
- Depth
 - Top 4 inches of sediment column (as average)
 - Top 2 ft of sediment column (as average)
- Associated RALs

Table 1 shows the rules as applied which are consistent with the draft ROD. The table does not include the provisional RAL for sediment deeper than 2 ft below mudline in the Federal channel used to define Dirty conditions in that interval, although that is considered in the following evaluation.

3.2 Evaluation of Dredged Material Management Units (DMMUs)

Because the USACE characterization comprises cores (as opposed to grab) data for each dredged material management unit (DMMU) characterized, it was necessary to assume that the topmost interval (these are shown in Table 2) is equivalent to both the top 2 ft and the top 4 inches for comparison to RALs. In most cases, there is only one sample per shoal in accordance with Dredged Material Management Program (DMMP) disposal-volume-related sampling protocols. (Two samples do occur in one long shoal, constituting one DMMU.) In accordance with the USACE navigation maintenance, when dredging occurs, it will remove sediment to the authorized navigation channel depth plus 2 ft deeper to accommodate contractual requirements and assure that navigation depths are maintained.

Seven sample locations (Table 2) fall in areas not already programmed for active cleanup; all were considered “MNR Below Benthic SCO” in the Proposed Plan. Two of the stations are in one long shoal (LDW07 and LDW08).

The stations shown in Table 3 are those that would have been designated MNR Below Benthic SCO, in accordance with data available at the time of the FS. Note that many of the top intervals exceed CSL for benzoic acid, although this may be rebutted by the bioassays conducted (i.e., they meet benthic SCOs based on biological criteria). All other shoals are in areas where remedial action is required in the Proposed Plan and draft ROD, and are not considered further in this analysis. The stations shown in Table 3 may be sorted into 2 categories: Dirty/Dirty and Clean/Dirty. There are 3 Clean/Dirty stations in 2 shoaled areas in the Federal channel and 4 dirty/dirty stations. As noted above, Clean/Dirty stations would not be subject to active remediation according to the draft ROD conditions listed in Table 1, but would not be able to be dredged for the navigation program based upon USACE (2013b), since at some depth interval they are unsuitable for open-water disposal at the Elliott Bay open-water dredged material disposal site.

Table 1. Remedial Action Levels for Subtidal Sediments (-4 ft MLLW and Deeper) and Depth Intervals for Their Application

Remedial Action Levels (RALs) and Depth Intervals for Their Application						
Contaminant	Units	Recovery Category 1 Areas and the Federal Channel ^a		Recovery Category 2 and 3 Areas		Risk Drivers
		4 in (10 cm) depth interval	2 ft (60 cm) depth interval	4 in (10 cm) depth interval	2 ft (60 cm) depth interval (applied only at potential tug scour areas) ^h	
PCBs (Total)	mg/kg-OC	12	12	12	195	Human Health Risk Reduction ^{b,c, d}
cPAH	µg TEQ/kg-dw	1000	1000	1000	--	
Dioxins/Furans	ng TEQ/kg-dw	25	25	25	--	
Arsenic (Total)	mg/kg-dw	57	57	57	--	
39 SMS Chemicals ^f	(Varies by Contaminant)	Benthic Sediment Cleanup Objective (SCO) ^f	SCO ^f	2xSCO ^{f, g}	--	Ecological Risk Reduction ^e

Notes

The average concentrations in a depth interval (e.g., vertically composited samples) are compared to RALs.

^a These RALs apply in the top 2 ft interval to all areas in the Federal navigation channel, regardless of Recovery Category designation.

^b RAO 1 - Human Health Seafood Consumption

^c RAO 2 - Human Health Direct Contact is Beach Play, Clamming, and Netfishing

^d RAO 4 - Ecological Protection for River Otter (Addressed by Meeting Human Health PCB RAL)

^e RAO 3 - Ecological Protection of Benthic Community

^f Washington State Sediment Management Standards (SMS) Sediment Cleanup Objective (SCO) are for 41 contaminants, but separate human health RALs are applied in their stead to arsenic and PCBs; the SMS also lists biological test criteria for bioassays. Biological test results do not supersede RALs for human health risk driver COCs.

^g RAL is "2x Benthic SCO." This RAL is for 39 COC and excludes the two COCs that are human health COCs (PCBs and arsenic). Demonstration (through modeling) that the COCs are predicted to recover to the SCO in 10 years is also required.

^h Potential tug scour areas are shown in Figure 16 of Draft ROD. Potential tug scour areas are subtidal elevations potentially susceptible to propeller wash, defined as shallower than -24 ft MLLW north of 1st Ave Bridge (located at approximately RM 2), and shallower than -18 ft MLLW south of 1st Ave Bridge. Below these water depths, RALs apply only to the 10 cm (4 inch) depth interval.

Table 2. Interpretation of Stations from 2012 Characterization and Remedial Assignments in the Proposed Plan

Station	Designated for Active Cleanup in Preferred Alternative?	Type of Cleanup Assigned in Preferred Alternative?	Length of Top Core Interval	Top Interval Compared to Chemical SMS, Results from <i>Eohaustorius</i> , <i>Neanthes</i> , and <i>Mytilus</i> Larval Bioassays, and Human Health RALs (<u>HH RALS Underlined</u>)	Chemical Maxima of Lower Core Intervals Exceeding Benthic SCO or Human Health RALs (<u>HH RALS Underlined</u>)	Include in Volume Estimate as Dirty/Dirty or Clean/Dirty?
LDW03	Yes	Dredge	4.4 ft	>SCO: Hg, PCB, 1,2,4-TCB, 2,4-DMP, <u>PCB</u> , <u>Dioxins</u> >CSL: Benzoic Acid, Benzyl Alcohol	Hg, 1,2,4-TCB, 2,4-DMP, PCB, Benzoic Acid, Benzyl Alcohol, Dibenzofuran, N-nitroso-diphenylamine, PAHs, DDT, <u>PCB</u> , <u>Dioxins</u>	
LDW04	Yes	Dredge	2.1 ft	>CSL: Hg, Benzyl Alcohol, <u>PCB</u>	Hg, 1,2,4-TCB, Benzyl Alcohol, <u>PCB</u> , <u>Dioxins</u>	
LDW06	No	MNR Below SCO	4.9 ft	>CSL: Benzyl Alcohol	1,2,4-TCB, Benzyl Alcohol, <u>PCB</u>	Dirty/Dirty
LDW07	No	MNR Below SCO	2 ft	>CSL: Benzyl Alcohol Bioassay: passed with minor hit ^a	1,2,4-TCB, Benzyl Alcohol, <u>PCB</u>	Clean/Dirty
LDW08	No	MNR Below SCO	4 ft	>CSL: Benzyl Alcohol Bioassay: passed with minor hit	Benzyl Alcohol, <u>PCB</u>	Clean/Dirty
LDW09	Yes	Dredge	2 ft	>CSL: Benzyl Alcohol Bioassay: passed with minor hit	1,2,4-TCB, Benzyl Alcohol, <u>PCB</u>	
LDW10	No	MNR Below SCO	2 ft	>SCO: PCB >CSL: Benzyl Alcohol	1,2,4-TCB, Benzyl Alcohol, <u>PCB</u>	Dirty/Dirty
LDW11	No	MNR Below SCO	2 ft	>CSL: Benzyl Alcohol Bioassay: passed with minor hit	1,2,4-TCB, Benzyl Alcohol, <u>PCB</u>	Clean/Dirty
LDW12	Yes	Dredging	2.6 ft	>SCO: 1,2,4-TCB >CSL: Benzyl Alcohol	Benzyl Alcohol, <u>PCB</u>	
LDW13	No	MNR Below SCO	2 ft	>SCO: 1,2,4-TCB >CSL: Benzyl Alcohol Bioassay: failed with major hit	1,2,4-TCB, Benzyl Alcohol, <u>PCB</u>	Dirty/Dirty
LDW14	No	MNR Below SCO	2 ft	>CSL: Benzyl Alcohol	Benzyl Alcohol, <u>PCB</u>	Dirty/Dirty
LDW15	Yes	Dredge	2 ft	>CSL: Benzyl Alcohol	Benzyl Alcohol	
LDW16	Yes	Dredge	2.5 ft	>CSL: Benzyl Alcohol Bioassay: failed with major hit	Benzyl Alcohol	
LDW17	Yes	Dredge	3.5 ft	>SCO: 1,2,4-TCB >CSL: Benzyl Alcohol Bioassay: failed with major hit	1,2,4-TCB, Benzyl Alcohol, <u>PCB</u>	
LDW18	Yes	Dredge	2 ft	>CSL: Benzyl Alcohol Bioassay: passed with minor hit	Benzyl Alcohol	

^a – All bioassay hits are for the *Mytilus* larval bioassay

Table 3. Interpretation in Terms of Table 1 Criteria

Station	Rationale		Issues Associated with Z-layer	
	RALs Exceeded in Top Interval (When CSL is Exceeded, SCO is Also)	Conclusion Under Selected Remedy Criteria in Draft ROD	Suitable for ENR? (Reason if Not)	Dioxins/Furans Antidegradation Issue Under DMMP Guidelines?
LDW06	Benthic CSL (Benzyl Alcohol)	Dredge	Yes	Yes
LDW07	Benthic CSL (Benzyl Alcohol) Rebutted by Bioassay	MNR Below Benthic SCO	No (Exceeds 3xPCB RAL)	No
LDW08	Benthic CSL (Benzyl Alcohol) Rebutted by Bioassay	MNR Below Benthic SCO	No (Exceeds 3xPCB RAL)	Yes
LDW10	Benthic CSL (Benzyl Alcohol), <u>PCB</u>	Dredge	Yes	Yes
LDW11	Benthic CSL (Benzyl Alcohol) Rebutted by Bioassay	MNR Below Benthic SCO	Yes	No
LDW13	Benthic CSL (Benzyl Alcohol and 1,2,4 Trichlorobenzene) Confirmed by Bioassay	Dredge	Yes	No
LDW14	Benthic CSL (Benzyl Alcohol)	Dredge	Yes	Yes

In Table 3, the Z-layer indicates the bottom of the dredge prism. The Z-layer for 2 locations (LDW07 and LDW08) do not meet ENR upper limits (3 times the PCB RAL), and, if subject to cleanup, would require additional dredging, capping, or partial dredging and capping. Note that it was not possible with current data for USACE to estimate the additional dredging depth or need for capping for these situations. Volumes presented assume that the Z layer would bound the amount of dredging, so the volumes may be biased low for these 2 locations.

Also, although the dioxins/furans RALs are met in the Z-layer at several locations, the Dredged Materials Management Program's (USACE 2013c) antidegradation requirement is that the Z-layer not exceed 10 ng TEQ/kg dw for dioxins/furans following dredging. In accordance with the assumptions in LDWG (2012a and 2013a), placement of a thin (6-9") layer of sand in these locations would be required, and would fulfill the DMMP requirement. However, the Federal dredging program does not do this, by policy; this limits the ability to address shoals with contamination at the Z layer.

3.3 Volume and Area Results

Figure 2, page following, shows the areas that would require dredging should all of the shoals be determined to be subject to active remediation.

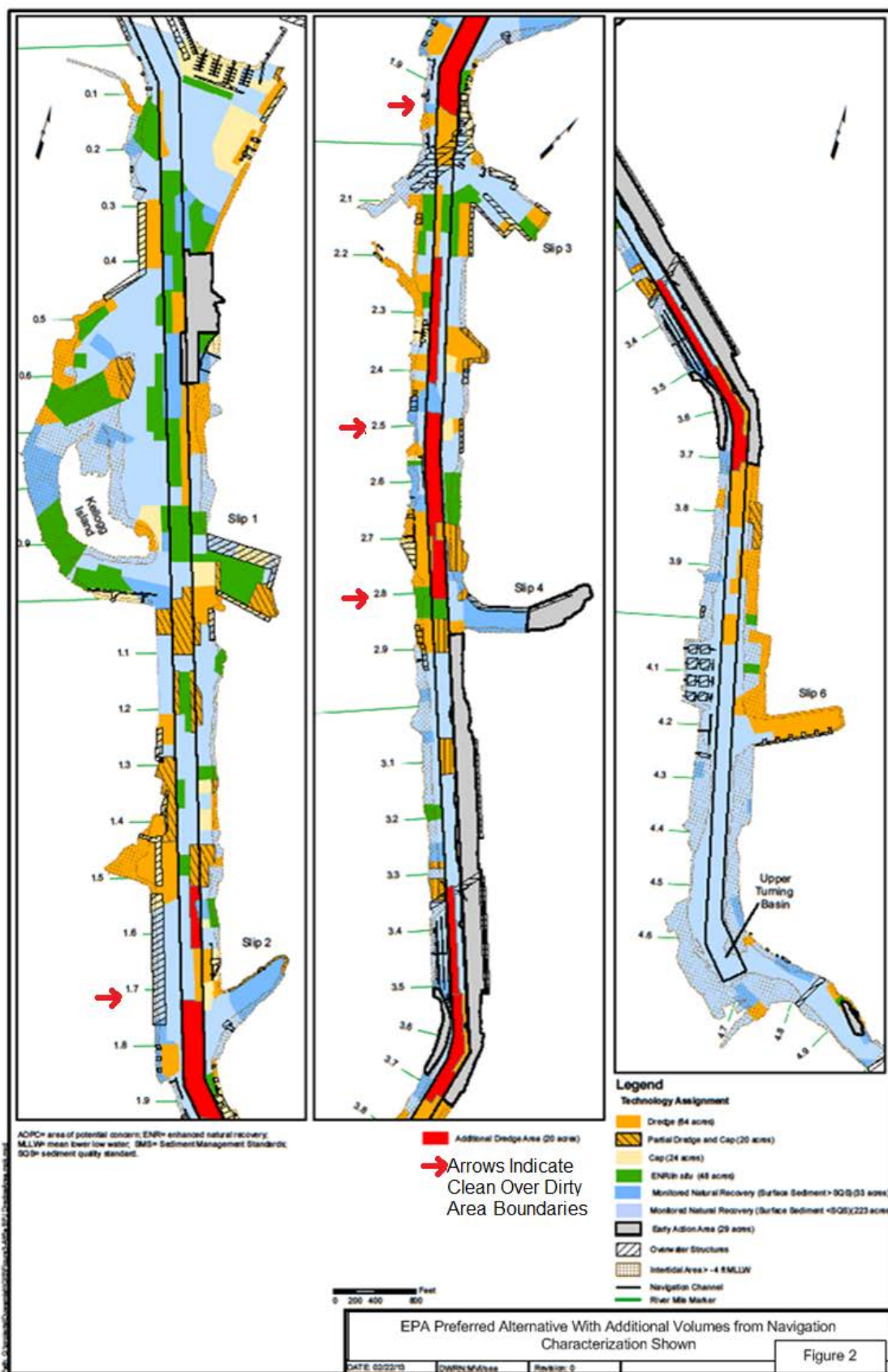


Figure 3. Additional Dredge Areas. Start and end of shoals corresponding to "Clean/Dirty" are indicated by red arrows.

Volumes below assume dredging to the depth of the authorized channel plus 2 ft, in accordance with an updated channel survey from 2013 (the most recent survey). The additional 2 ft is equivalent to the USACE “over-draft” depth, but is applied to address residual contamination and accommodate ENR, as appropriate. Microstation™ was used for the estimation of precise volumes.

Tables 4 and 5 shows the calculated volumes and areas for those stations that respectively represent Dirty/Dirty and Clean/Dirty shoals. For dredging all shoals, the volume would increase by 160,000 CY. Note: because these volumes were characterized in accordance with detailed bathymetry and consider side slopes, they are not the neat-line calculations as in the FS.

Table 4. Estimated Additional Volumes and Acreages for Dirty/Dirty Shoals

Location/Shoal	Additional Volume (CY)	Additional Area (ac)
LDW06	6,926	1.2
LDW10	15,441	2.4
LDW13	13,857	1.9
LDW14	18,847	3.0
Additional Volume/Area from USACE Characterization	55,071 ^a	9

^a - Table 6, below, considers the joint effect of this volume with the cap buffer volume of 14,000 CY. 55,000 + 14,000 is summed to 69,000 CY, and rounded to 70,000 CY for Scenario 1.

Table 5. Estimated Additional Volumes, Acreages, and Cost for Clean/Dirty Shoals

Location/Shoal	Additional Volume (CY)	Additional Area (ac)
LDW07-08 ^a	64,284	5.7
LDW11	35,712	6.0
Additional Volume/Area from USACE Characterization	99,996 (rounded to 100,000)	12

^a - These shoals were contiguous, and have been considered together. Note also that LDW07-08 may require additional volumes due to additional dredging and partial capping; these were not possible to estimate from the available information. In the following table, this shoal was considered partial dredge and cap.

Table 6 compares the sum of Tables 4 and 5 areas/volumes along with that of the additional cap buffer zone to that in LDWG (2013a), which established the Proposed Plan’s Preferred Alternative.

Table 6. Comparison to Preferred Alternative Parameters

Remedial Alternative	Remedial Technology and Areas										Dredge-cut Prism Volume (Rounded to Nearest 10,000 CY)	Performance Contingency Volume (cy)	Total Dredge Volume (Rounded to Nearest 10,000 CY)
	EAAs (acres)	Areas Actively Remediated				Areas without Active Remediation		Total Active Area (acres)	Total Area Not Actively Remediated (acres)	Total Study Area (acres) (includes EAAs)			
		Dredge (acres)	Partial Dredge and Cap (acres)	Cap (acres)	ENR or ENR/ <i>in situ</i> Treatment (acres)	MNR To Benthic SCO (acres)	MNR Below Benthic SCO (acres)						
EPA Preferred Alternative (LDWG 2013a)	29	64	20	24	48	33	223	156	256	441	670,000	120,000	790,000
Additional area and volumes for Scenario 1 (shoals identified in Table 4 would be dredged and cap buffer provided)	29	73	20	24	48	33	214	165	247	441	740,000 ^a	120,000 ^b	860,000
Additional area and volumes for Scenario 2 (shoals identified in Table 5 would be dredged)	29	85	20	24	48	33	202	177	235	441	840,000 ^c	120,000 ^b	960,000

^a - Performance contingency volumes were not increased for the additional dredged volumes, as these volumes were intended in the FS to constitute the contingent volumes.

^b – Sums the 70,000 from Table 4, footnote *a* with the base case.

^c – Sums Scenario 1 plus 100,000 CY from Table 5.

4. Summary and Changes to Costs

USACE used the FS cost assumptions to generate costs associated with Scenarios 1 and 2, as well as additional information requested from LDWG detailing the method of calculation of net present value (LDWG 2014). Appendix A presents the cost estimate as Base, Scenario 1 and Scenario 2. Table 7 shows cost at net present value with a 2.3% discount rate, and Table 8 shows influence of other discount rates used in the Proposed Plan and ROD.

Table 7. Comparison of Acreages, Volumes and Costs at 2.3% Discount Rate. (Capital plus Operations, Monitoring, and Maintenance, OMMM)

Case	Acres	Dredge Volume	Cost (\$M) at 2.3% Discount Rate
Base (Alt 5C Plus)	84	790,000	305
Added Scenario 1 Quantities	9 ^a	70,000 ^b	15
Scenario 1	93	860,000	320
Added Scenario 2 Quantities	12	100,000	22
Scenario 1+2	105	960,000 ^c	342

^a There was no significant acreage increase associated with the cap buffer adjustment

^b This includes 55,000 CY from additional characterization (Dirty/Dirty) and 14,000 CY from additional cap buffer, rounded to the nearest 10,000 cy.

^c This includes an additional 100,000 CY from the Clean/Dirty shoals

Table 8. Comparison of Other Discount Rates (Capital Plus OMMM)

Case	Cost at 0% Discount Rate (\$M)	Cost at 7% Discount Rate (\$M)
Base (Alt 5C Plus)	348	247
Scenario 1	367	257
Scenario 1+2	395	270

References Cited

1. Lower Duwamish Work Group (LDWG). 2012a. Final Feasibility Study Lower Duwamish Waterway, Seattle, Washington. Submitted to U.S. EPA, Seattle, WA, and Ecology, Bellevue, WA.
2. LDWG. 2012b. Technical Memorandum: Supplement to the Feasibility Study for the LDW Superfund Site, Approaches for Addressing Additional Concerns in Alternative 5C and Development of Alternative 5C Plus Scenarios. Submitted to U.S. EPA, Seattle, WA, and Ecology, Bellevue, WA.

3. LDWG. 2013a. Development of Final Technology Assignments and Modifications to Alternative 5C Plus Scenario 5a in Support of EPA's Selected Remedy. Submitted to U.S. EPA, Seattle, WA, and Ecology, Bellevue, WA.
4. LDWG 2013b. Letter from multiple parties to Allison Hiltner, dated 13 June 2013, Subject Comments on the EPA Proposed Plan. Attachment 1, Comment 1.5, et al.
5. LDWG 2014. Additional Information on Cost Estimate, Undiscounted. Provided at request of USACE to Allison Hiltner, EPA, 8/26/2014.
6. US Army Corps of Engineers (USACE). 2013a. Data Report -Lower Duwamish Waterway, East Waterway, and West Waterway Subsurface Sediment Characterization. Seattle, Washington. Prepared by HDR Engineering, Inc., Science and Engineering for the Environment LLC, and Ken Taylor Associates. URL:
http://www.nws.usace.army.mil/Portals/27/docs/civilworks/dredging/Suitability%20Determinations/2013/Duwamish_Data_Report_05202013.pdf
7. USACE 2013b. Letter from Bruce A. Estok, Department of the Army, Seattle District, Corps of Engineers to Allison Hiltner, dated 14 June 2013, Subject: comments in response to the Proposed Plan for the Lower Duwmaish Superfund Site dated 28 February 2013.
8. USACE 2013c. Dredged Material Evaluation and Disposal Procedures User Manual, July 2013.
<http://www.nws.usace.army.mil/Portals/27/docs/civilworks/dredging/UM%202013/UM%20Final%20131118.pdf>

Appendix A – Cost Estimates

TASK 5C + Scenario 1 (60,000CY Dirty/Dirty Dredge + 14,000 CY Cap)	UNIT COSTS	UNIT	QUANTITY / SUBTOTAL
PRECONSTRUCTION			
Mob, Demob & Site Restoration (project)	\$ 800,000	Lump Sum	1
Mob, Demob & Site Restoration (seasonal)	\$ 120,000	YEAR	9.4
Land Lease for Operations & Staging	\$ 250,000	YEAR	9.4
Contractor Work Plan Submittals	\$ 100,000	YEAR	9.4
Barge Protection	\$ 80,000	Lump Sum	1
Subtotal:			\$ 5,301,205
PROJECT MANAGEMENT (CONTRACTOR)			
Labor & Supervision	\$ 62,000	MONTH	43.3
Construction Office & Operating Expense	\$ 21,600	MONTH	43.3
Subtotal:			\$ 3,617,486
DREDGING			
Shift Rate	\$ 25,963	DAY	828
Gravity Dewatering (on the barge)	\$ 10	CY	850,664
Subtotal:			\$ 30,004,004
SEDIMENT HANDLING & DISPOSAL			
Transloading Area Setup	\$ 1,000,000	Lump Sum	1
Water Management	\$ 10,000	DAY	828
Transload, Railcar Transport to & Tipping at Subtitle D Landfill	\$ 60	TON	1,275,997
Subtotal:			\$ 85,839,820
SEDIMENT CAPPING, DREDGE RESIDUALS, DREDGE BACKFILL			
Debris Sweep	\$ 30,000	ACRE	2
Shift Rate (12 hours)	\$ 12,500	DAY	501
Cap Material Procurement & Delivery (sand)	\$ 27	CY	548,103
Subtotal:			\$ 21,121,281
ENHANCED NATURAL RECOVERY			
Debris Sweep	\$ 30,000	ACRE	5
Shift Rate (12 hours)	\$ 12,500	DAY	46
Material Procurement & Delivery (sand)	\$ 27	CY	28,824
Material Procurement & Delivery (carbon amended sand)	\$ 161	CY	28,824
Subtotal:			\$ 6,143,912
CONSTRUCTION QA/QC			
Construction Monitoring	\$ 7,925	DAY	828
Subtotal:			\$ 6,561,900
POST-CONSTRUCTION PERFORMANCE MONITORING			
Compliance Testing (Dredging)	alt specific	PROJECT	\$ 1,293,240
Compliance Testing (Capping)	alt specific	PROJECT	\$ 1,141,320
Compliance Testing (ENR)	alt specific	PROJECT	\$ 1,221,569
Subtotal:			\$ 3,656,130
CAPITAL COSTS (base)			\$ 162,245,737
CAPITAL COSTS (2.3%)			\$ 147,733,938
CAPITAL COSTS (7.0%)			\$ 124,132,030
Construction Contingency	35%	PROJECT	\$ 56,786,008
Sales Tax	9.5%	PROJECT	\$ 15,413,345
Project Management, Remedial Design & Baseline Monitoring	30%	PROJECT	\$ 48,673,721
Construction Management	10%	PROJECT	\$ 16,224,574
TOTAL CAPITAL COST (base)			\$ 299,343,385
TOTAL CAPITAL COST (2.3%)			\$ 272,569,115

TASK 5C + Scenario 1 (60,000CY Dirty/Dirty Dredge + 14,000 CY Cap)	UNIT COSTS	UNIT	QUANTITY / SUBTOTAL
TOTAL CAPITAL COST (7.0%)			\$ 229,023,596
AGENCY OVERSIGHT, REPORTING, O&M, & MONITORING COSTS (base)			
Agency Review & Oversight	alt specific	PROJECT	\$ 10,200,000
Reporting	alt specific	PROJECT	\$ 1,900,000
Operations & Maintenance (Dredging)	alt specific	PROJECT	\$ 1,416,056
Operations & Maintenance (Capping)	alt specific	PROJECT	\$ 5,907,000
Operations & Maintenance (ENR)	alt specific	PROJECT	\$ 6,352,496
Operations & Maintenance (MNR>SCO)	alt specific	PROJECT	\$ 2,250,956
Operations & Maintenance (MNR<SCO)	alt specific	PROJECT	\$ 8,978,076
Long-term Monitoring	alt specific	PROJECT	\$ 5,775,580
Institutional Controls	alt specific	PROJECT	\$ 25,000,000
Subtotal (base):			\$ 67,780,164
Subtotal (2.3%):			\$ 47,504,279
Subtotal (7.0%):			\$ 27,542,642
TOTAL COST (Net Present Value) not discounted			\$ 367,123,549
TOTAL COST (Net Present Value) at 2.3% discount rate			\$ 320,073,394
TOTAL COST (Net Present Value) at 7.0% discount rate			\$ 256,566,238

TASK 5C + Scenario 1 + Scenario 2 (100,000CY)	UNIT COSTS	UNIT	QUANTITY / SUBTOTAL
PRECONSTRUCTION			
Mob, Demob & Site Restoration (project)	\$ 800,000	Lump Sum	1
Mob, Demob & Site Restoration (seasonal)	\$ 120,000	YEAR	10.5
Land Lease for Operations & Staging	\$ 250,000	YEAR	10.5
Contractor Work Plan Submittals	\$ 100,000	YEAR	10.5
Barge Protection	\$ 80,000	Lump Sum	1
Subtotal:			\$ 5,813,932
PROJECT MANAGEMENT (CONTRACTOR)			
Labor & Supervision	\$ 62,000	MONTH	48.3
Construction Office & Operating Expense	\$ 21,600	MONTH	48.3
Subtotal:			\$ 4,037,006
DREDGING			
Shift Rate	\$ 25,963	DAY	924
Gravity Dewatering (on the barge)	\$ 10	CY	950,664
Subtotal:			\$ 33,496,452
SEDIMENT HANDLING & DISPOSAL			
Transloading Area Setup	\$ 1,000,000	Lump Sum	1
Water Management	\$ 10,000	DAY	924
Transload, Railcar Transport to & Tipping at Subtitle D Landfill	\$ 60	TON	1,425,997
Subtotal:			\$ 95,799,820
SEDIMENT CAPPING, DREDGE RESIDUALS, DREDGE BACKFILL			
Debris Sweep	\$ 30,000	ACRE	2
Shift Rate (12 hours)	\$ 12,500	DAY	501
Cap Material Procurement & Delivery (sand)	\$ 27	CY	548,103
Subtotal:			\$ 21,121,281
ENHANCED NATURAL RECOVERY			
Debris Sweep	\$ 30,000	ACRE	5
Shift Rate (12 hours)	\$ 12,500	DAY	46
Material Procurement & Delivery (sand)	\$ 27	CY	28,824
Material Procurement & Delivery (carbon amended sand)	\$ 161	CY	28,824
Subtotal:			\$ 6,143,912
CONSTRUCTION QA/QC			
Construction Monitoring	\$ 7,925	DAY	924
Subtotal:			\$ 7,322,700
POST-CONSTRUCTION PERFORMANCE MONITORING			
Compliance Testing (Dredging)	alt specific	PROJECT	\$ 1,445,267
Compliance Testing (Capping)	alt specific	PROJECT	\$ 1,141,320
Compliance Testing (ENR)	alt specific	PROJECT	\$ 1,221,569
Subtotal:			\$ 3,808,157
CAPITAL COSTS (base)			\$ 177,543,260
CAPITAL COSTS (2.3%)			\$ 159,745,069
CAPITAL COSTS (7.0%)			\$ 131,453,592
Construction Contingency	35%	PROJECT	\$ 62,140,141
Sales Tax	9.5%	PROJECT	\$ 16,866,610
Project Management, Remedial Design & Baseline Monitoring	30%	PROJECT	\$ 53,262,978
Construction Management	10%	PROJECT	\$ 17,754,326
TOTAL CAPITAL COST (base)			\$ 327,567,314
TOTAL CAPITAL COST (2.3%)			\$ 294,729,653
TOTAL CAPITAL COST (7.0%)			\$ 242,531,878

TASK 5C + Scenario 1 + Scenario 2 (100,000CY)	UNIT COSTS	UNIT	QUANTITY / SUBTOTAL
AGENCY OVERSIGHT, REPORTING, O&M, & MONITORING COSTS (base)			
Agency Review & Oversight	alt specific	PROJECT	\$ 10,200,000
Reporting	alt specific	PROJECT	\$ 1,900,000
Operations & Maintenance (Dredging)	alt specific	PROJECT	\$ 1,416,056
Operations & Maintenance (Capping)	alt specific	PROJECT	\$ 5,907,000
Operations & Maintenance (ENR)	alt specific	PROJECT	\$ 6,352,496
Operations & Maintenance (MNR>SCO)	alt specific	PROJECT	\$ 2,250,956
Operations & Maintenance (MNR<SCO)	alt specific	PROJECT	\$ 8,978,076
Long-term Monitoring	alt specific	PROJECT	\$ 5,775,580
Institutional Controls	alt specific	PROJECT	\$ 25,000,000
Subtotal (base):			\$ 67,780,164
Subtotal (2.3%):			\$ 47,504,279
Subtotal (7.0%):			\$ 27,542,642
TOTAL COST (Net Present Value) not discounted			\$ 395,347,478
TOTAL COST (Net Present Value) at 2.3% discount rate			\$ 342,233,932
TOTAL COST (Net Present Value) at 7.0% discount rate			\$ 270,074,520